

87 + 11 = 98

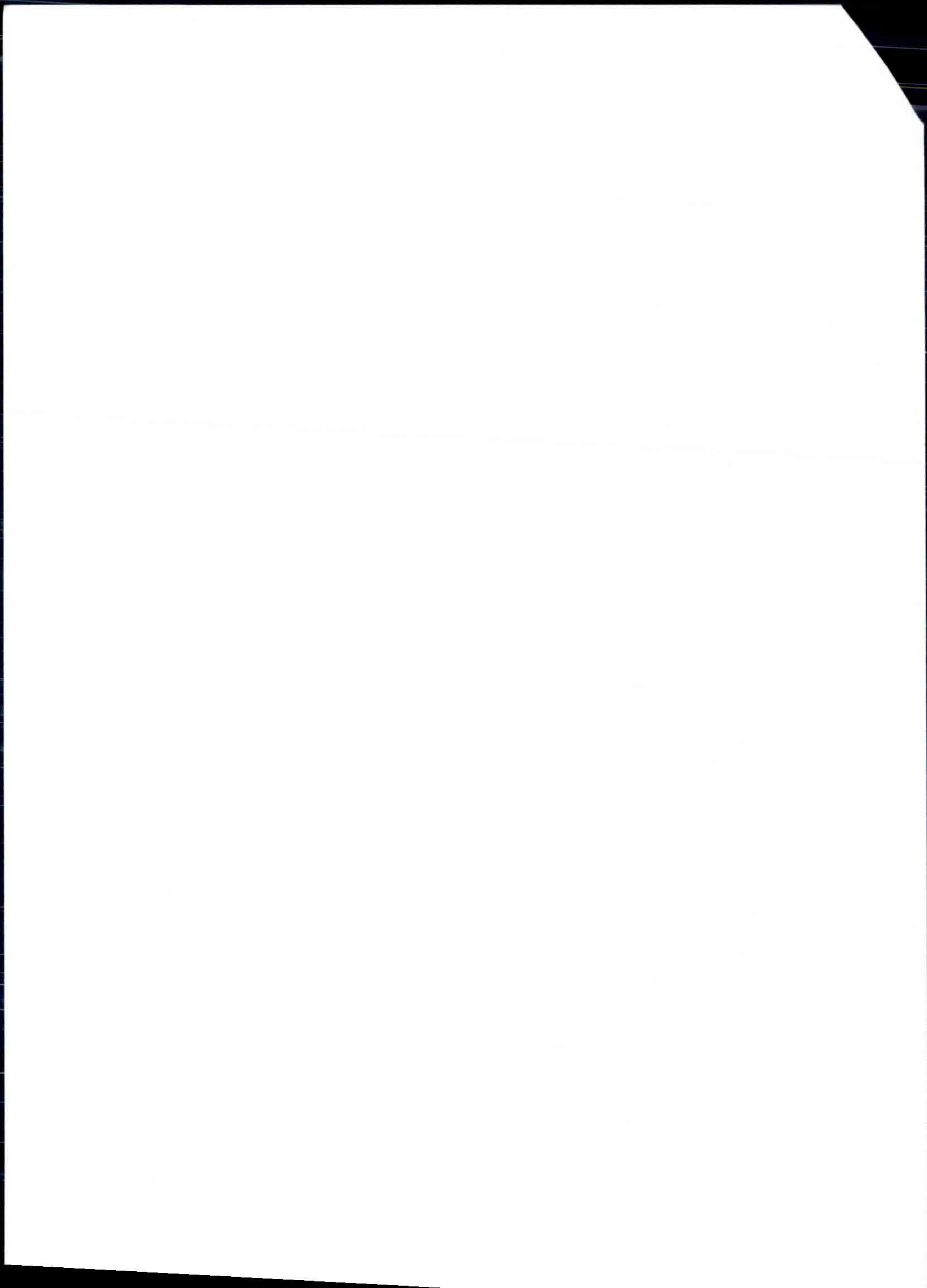
Part A – Multiple Choice (20 points) – circle the letter of the correct answer

- ✓ 1. In which part of the neuron are synaptic vesicles found?
a. Cell body
b. Dendritic spines
c. Axon hillock
d. Axon terminals
- ✓ 2. The major function of Schwann cells is
a. transmission of nutrients to neurons.
b. myelination of peripheral nerve fibers.
c. scavenging of cellular debris.
d. myelination of axons in the brain.
- X 3. The sodium–potassium pump is responsible for
a. removing three sodium ions for every two potassium ions from the cell membrane.
b. initiating the action potential.
c. returning the membrane potential to the resting state.
d. Both a and c
- ✓ 4. ACh is the main transmitter used at mammalian
a. cerebral cortical synapses.
b. spinal cord synapses.
c. neuromuscular junctions.
d. visual system synapses.
- ✓ 5. The specialized presynaptic membrane receptors that remove molecules of transmitter from the synapse are called
a. translators
b. transponders
c. transporters
d. ligand-gated channels
- ✓ 6. Which of the following is *not* a consequence of parasympathetic activation?
a. Increased salivation
b. Increased heart rate
c. Decreased blood pressure
d. Increased digestion
- ✓ 7. In its common usage, the term *stroke* refers to
a. brain lesions caused by a reduction or blockage of blood flow to the brain.
b. brain lesions caused by leakage of cerebrospinal fluid.
c. brain injury due to head trauma.
d. any process that causes a sudden intellectual deterioration.

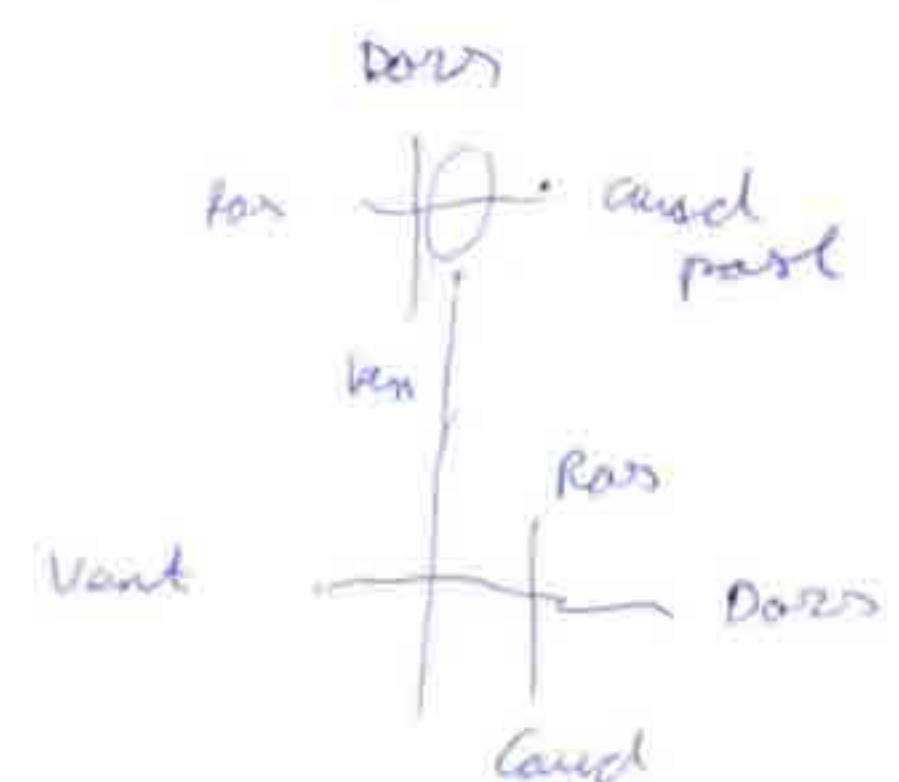


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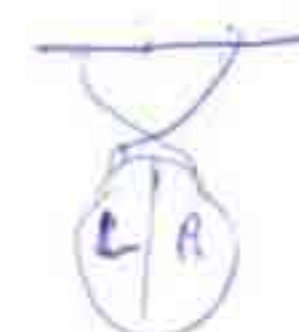


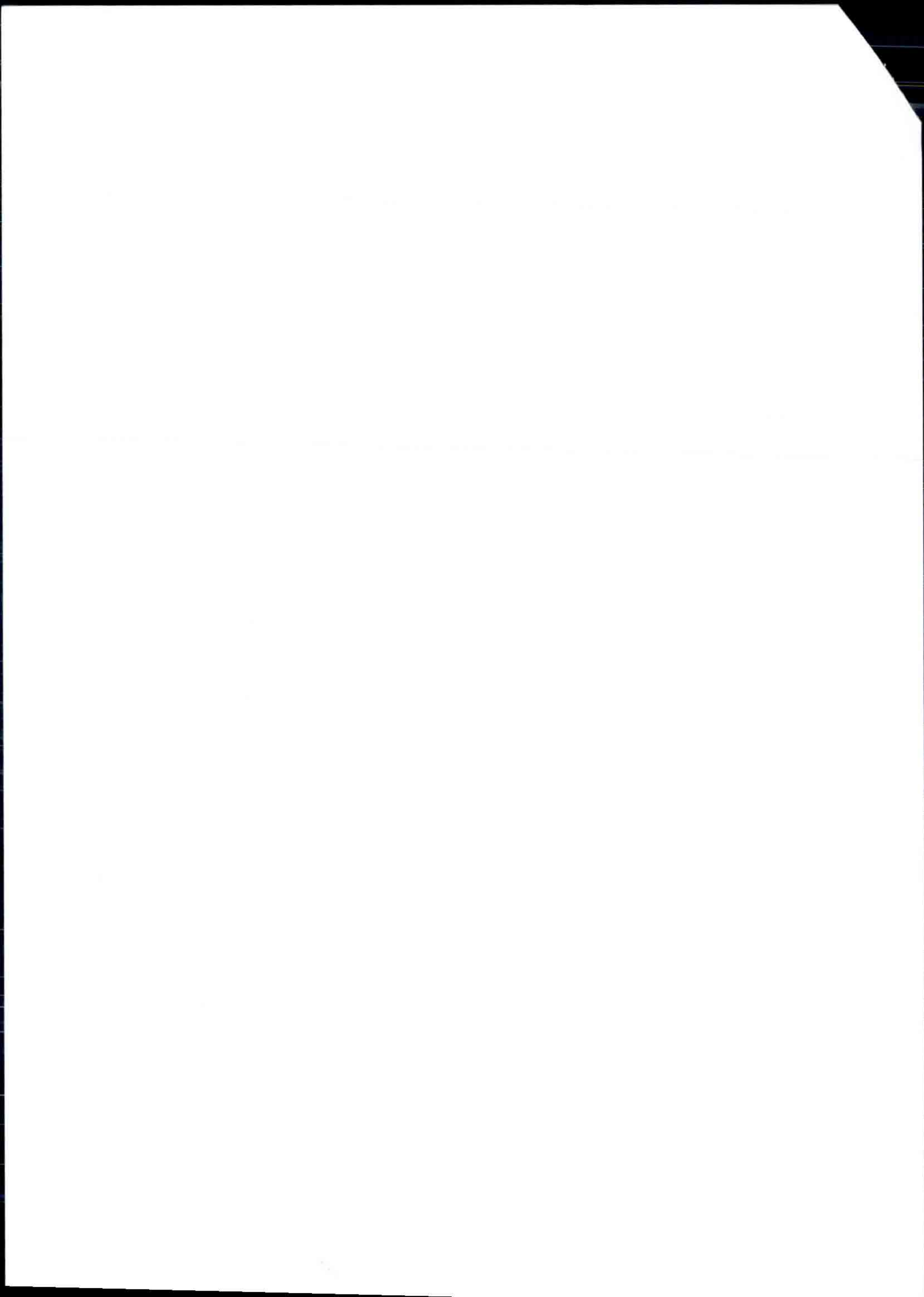
- ✓ 8. Which of these is *not* a catecholamine neurotransmitter?
a. Dopamine
b. Serotonin
c. Epinephrine
d. Norepinephrine
- ✓ 9. For an NMDA receptor channel to open
a. Both GABA needs to be present and the membrane needs to be depolarized
b. Both GABA needs to be present and the membrane needs to be hyperpolarized
c. Both glutamate needs to be present and the membrane needs to be depolarized
d. Both glutamate needs to be present and the membrane needs to be hyperpolarized
- ✓ 10. The process of transcription
a. is from DNA to RNA, and occurs in the nucleus
b. is from DNA to RNA, and occurs in the ribosome
c. is from RNA to protein, and occurs in the nucleus
d. is from RNA to protein, and occurs in the ribosome
- ✓ 11. RNA
a. is double stranded
b. is single stranded
c. is found only in the nucleus
d. is always a template for protein synthesis
- X 12. The phenotype
a. will always be guided by recessive alleles
b. express the genotype only
c. will be guided by dominant alleles only if heterozygous
d. is affected by both nature and nurture
- X 13. Crossing over
a. creates new combinations of maternal and paternal genes on any given chromosome
b. describes the situation when axons from different neurons meet but each continues to a different direction (as in traffic junctions)
c. is when the information in a postsynaptic cell from one neuron is being displaced by the information from another neuron
d. is a process in which chromosomes exchange equivalent segments of DNA during mitosis
- ✓ 14. Contralateral structures are
a. one is caudal to the other (which is rostral to the first)
b. on opposite sides of the midline
c. lateral to each other
d. one is proximal and the other is distal



- ✓ 15. The blood-brain barrier
- a. is a part of the immune system, involving the release of antibodies to protect the brain from infectious agents.
 - ⓑ. is a property of the closely packed cells that build the walls of brain capillaries, preventing large molecules from entering the brain.
 - c. is a property of the blood vessels of the brain that prevents the diffusion of water into the tissue of the brain.
 - d. is a property of neurons that prevents them from accidentally releasing their neurotransmitters into the blood circulation.
- ✓ 16. Which of the following is *Wrong* regarding opiates
- a. there are opioid receptors in the periaqueductal gray
 - b. endogenous substances which activate receptors for opiates are called endorphins
 - ⓐ. THC-9 is synthesized from opium
 - d. at high doses, opiates depress respiration
- ✓ 17. Which of the following is *Wrong* regarding MRI images
- a. Under specific magnetic and radio conditions, different tissues with different physical traits react differently
 - b. Differences in physical reactions of tissues are translated into different colors
 - c. The strength of commonly used MRI scanners is at least 30,000 times the earth's magnetic field
 - ⓓ. In a strong magnetic field hydrogen atoms are randomly aligned
- ✓ 18. fMRI
- a. measures electrical neural activity directly
 - b. is based on the fact that a local increase in neural activity demands increased glucose
 - ⓐ. is based on the Blood Oxygenation Level Dependent signal
 - d. uses a radioactive tracer injected into the bloodstream in order to see changes in neurovascular coupling
- ✓ 19. Cocaine
- a. is mainly a serotonin agonist
 - ⓓ. especially blocks the reuptake of dopamine
 - c. mainly affects the sympathetic system directly
 - d. can produce schizophrenia-like symptoms
- ✓ 20. Split-brain patients:
- ⓐ. have difficulty to verbally describe stimuli presented in the left-visual-field
 - b. have difficulty to verbally describe stimuli presented in the right-visual-field
 - c. both a and b
 - d. neither a or b

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Part B – Short Answer (40 points)

- ✓ 1. What disease is related to the degeneration of the substantia nigra? ↓ Dopamine

Parkinson's disease

- ✓ 2. During their absolute refractory period, neurons don't fire another action potential.

- ✗ 3. What characteristic of the neural membrane is responsible for the differential concentrations of ions inside and outside the neuron?

selectivity permeability (myelin sheath fatty tissue)

- ✓ 4. The neural membrane must become depolarised relative to its resting membrane potential in order for an action potential to occur.

- ✗ 5. Conduction velocity of action potentials is increased in axons with

myelinated diameters.

- ✓ 6. True or false? Metabotropic receptors liberate chemical second messengers.

True

- ✓ 7. A gas that is a neurotransmitter is nitric oxide.

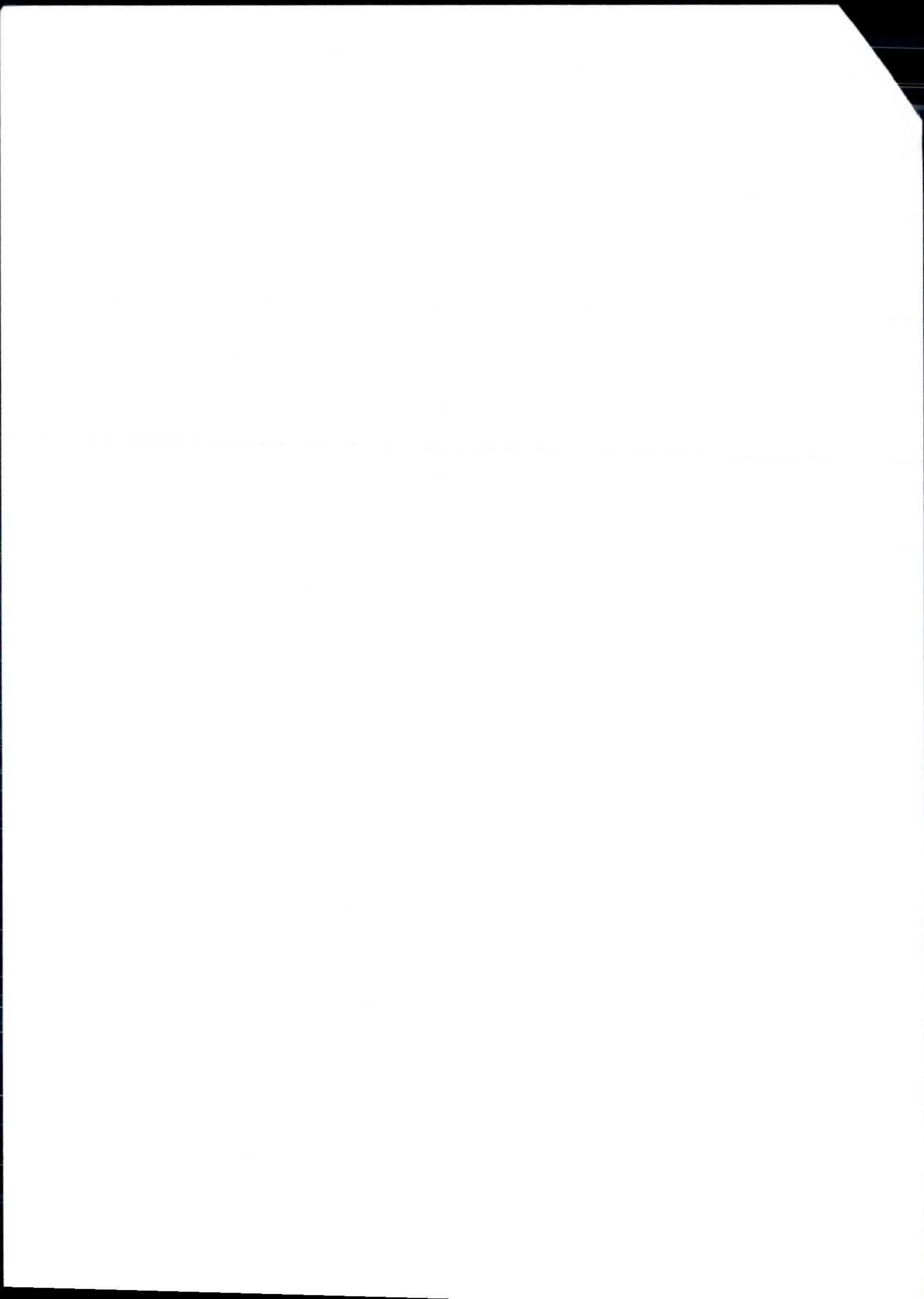
- ✓ 8. One important way that alcohol alters the functioning of the brain is as an agonist of GABA receptors.

- ✓ 9. Serotonergic neurons are located in the Raphe nuclei.

- ✓ 10. Mitochondria is the cellular organelle responsible for cellular respiration.

- ✓ 11. The processes of cell division for growth is called mitosis.

gradient



- X 12. A sequence of 3 nucleotides coding for 1 amino-acid is called a
protéine.
- X 13. How many neurons does the human brain contain? 200,000.
- X 14. Cells with numerous branching dendrites are called multineurons
~~Polysynaptic neurons~~ neurons.
- ✓ 15. The choroid plexus produces the Cerebral Spinal
Fluid.
- ✓ 16. The primary visual cortex is in the Occipital lobe.
- X 17. Receptors that contain channels for sodium or chlorine, e.g., are
Voltage-dependent channels; those without channels are Ligand-gated.
^{Na⁺} ^{Cl⁻} ^{example}
- ✓ 18. Norepinephrine is produced from Dopamine, and
Epinephrine is produced from Norepinephrine.
- ✓ 19. fMRI temporal resolution is in the order of 1-3 seconds.
- ✓ 20. The degree of chemical attraction between a ligand and a receptor is called
affinity.

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40

Part 3 – Essay Questions (25 points)

Answer 5 out of the following 8 questions (5 points each = 25 points).

You may also answer one more question for 5 bonus points.

At the beginning of your answer, write the number of the question you are answering.

You may continue on the other side of the page if needed.

- ①. Name four types of glial cells, and describe three important functions that glial cells perform.
2. Compare and contrast at least three different human brain imaging technologies through discussion of their technical bases and the types of information each provides.
- ③. Explain temporal and spatial summation of IPSPs and EPSPs.
- ④. List 5 characteristics (properties) of a substance necessary for it to be considered a neurotransmitter.
5. Describe up to 5 ways that medicinal drugs or drugs of abuse may affect post-synaptic processes.
- ⑥. Describe the process leading from a gene to the creation of a mature protein – how is a gene recognized, which molecules are involved, what are the names of the sub-processes, where does each sub-process take place, how is the correct protein sequence created.
7. Describe the production, functions, and structures containing cerebrospinal fluid, and problems that can be caused when the CSF system malfunctions.
- ⑧. Describe mitosis and meiosis, when and in which cells does each one occur, and how many chromosomes are in each daughter cell by the end of each process.

(Use this page to continue Essay answers if required)

- 1/15
- ① Microglia = clear debris ~~in~~ but are also seen eating healthy neighbouring neurons.
- ② Macrogia split up in 3 different types:
- ⓐ Astrocytes:
 - clear debris
 - isolate synaptic gap
 - provide structure ~~and~~ to neurons so they don't float around and nibble
 - clear dead ~~cells~~ neurons, but by this create scar tissue that prevent rebuilding of ~~neuron~~ axons, connections.
 - myelinate
 - ⓑ Oligodendrocytes: found in CNS myelination of axon
 - ⓒ Schwann cells: found in PNS myelination of axons and help in rebuilding structures.
- ⑥ in nucleus the DNA is placed, in a process of transcription a RNA polymerase unfolds part of DNA helix and copies in same (nucleotide) language the sequence for a protein, this starts at a promoter on DNA and ends by terminator.
- The RNA goes through a process of splicing (cutting out introns, a non coding sequence and connecting Exons, scattered pieces of protein coding sequences) RNA is then mRNA and can go out the nucleus and sit on a Ribosome, attached to the ER (Endoplasmic reticulum) an anti-codon there translates in } sequence of 3 nucleotides to 1 amino acid, which is tRNA, the strand of tRNA gets moved to the golgi apparatus and folded into a protein.

⑤ Criteria for neurotransmitter:

- ✓ 1) a neurotransmitter must be synthesized within the cell body.
- ✓ 2) the substance must ~~only~~ be released ~~when~~ at arrival of an ~~asufficient amount of~~ action potential.
- ✓ 3) at the arrival of an action potential an sufficient amount is released.
- ✓ 3) The change it causes on the presynaptic neuron causes a change on the post synaptic neuron.
- ✓ 4) We must be able to duplicate the action on the ~~pres~~ postsynaptic neuron.
- ✓ 5) ~~The~~ a substance exists that causes the end of the transmission.

⑤ Temporal summation: is when more ^{than 1} neurons fire at the same time, causing the ~~the~~ post-neuron to fire.
 Summing the PSPs

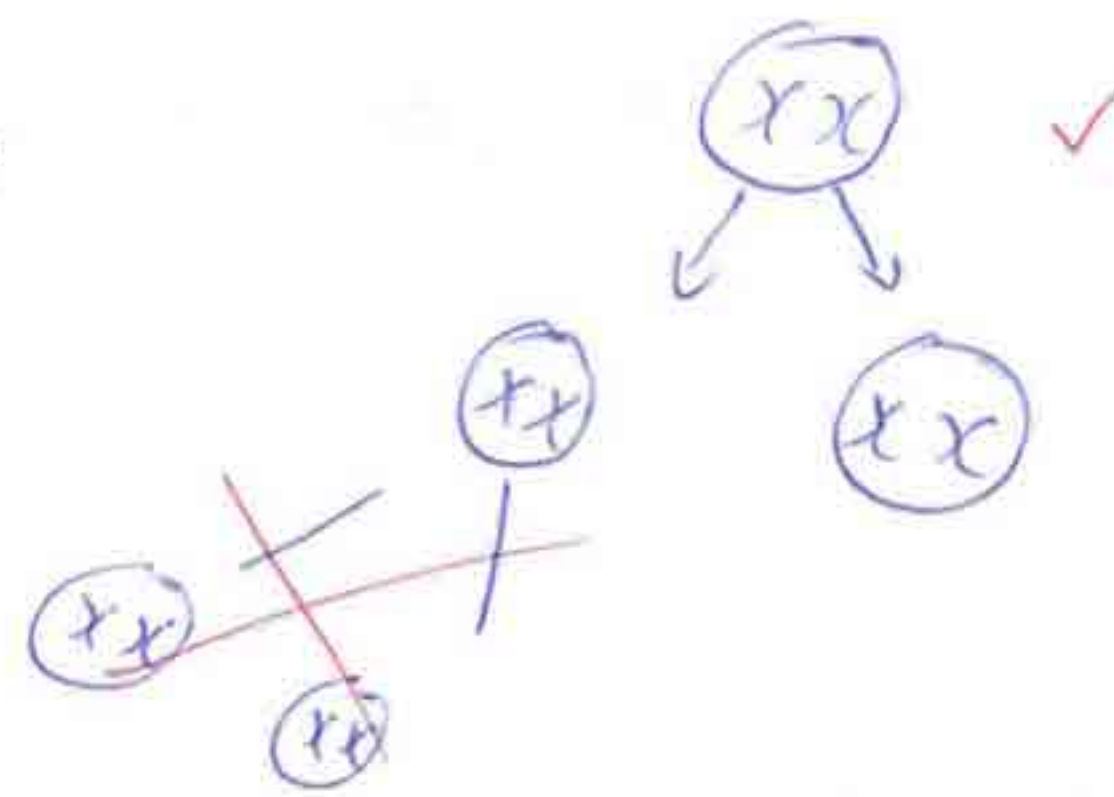
Spatial summation: is when 1 neuron has a strong enough firing that causes the post-neuron to fire.
 (like a loud friend)

IPSP inhibitory post synaptic potential relates to Spatial summation where both + and - runs in and its a matter of voting to fire yes or no.
 Inhibitory means you ~~de~~ reduce the action potential
 [↑] likelihood of

EPSP Excitatory post synaptic potential relates to Temporal summation, since it ~~excites~~ excites so increases the likelihood of action potential.
 If one neuron ~~it~~ excites enough, it will fire.

(Use this page to continue Essay answers if required)

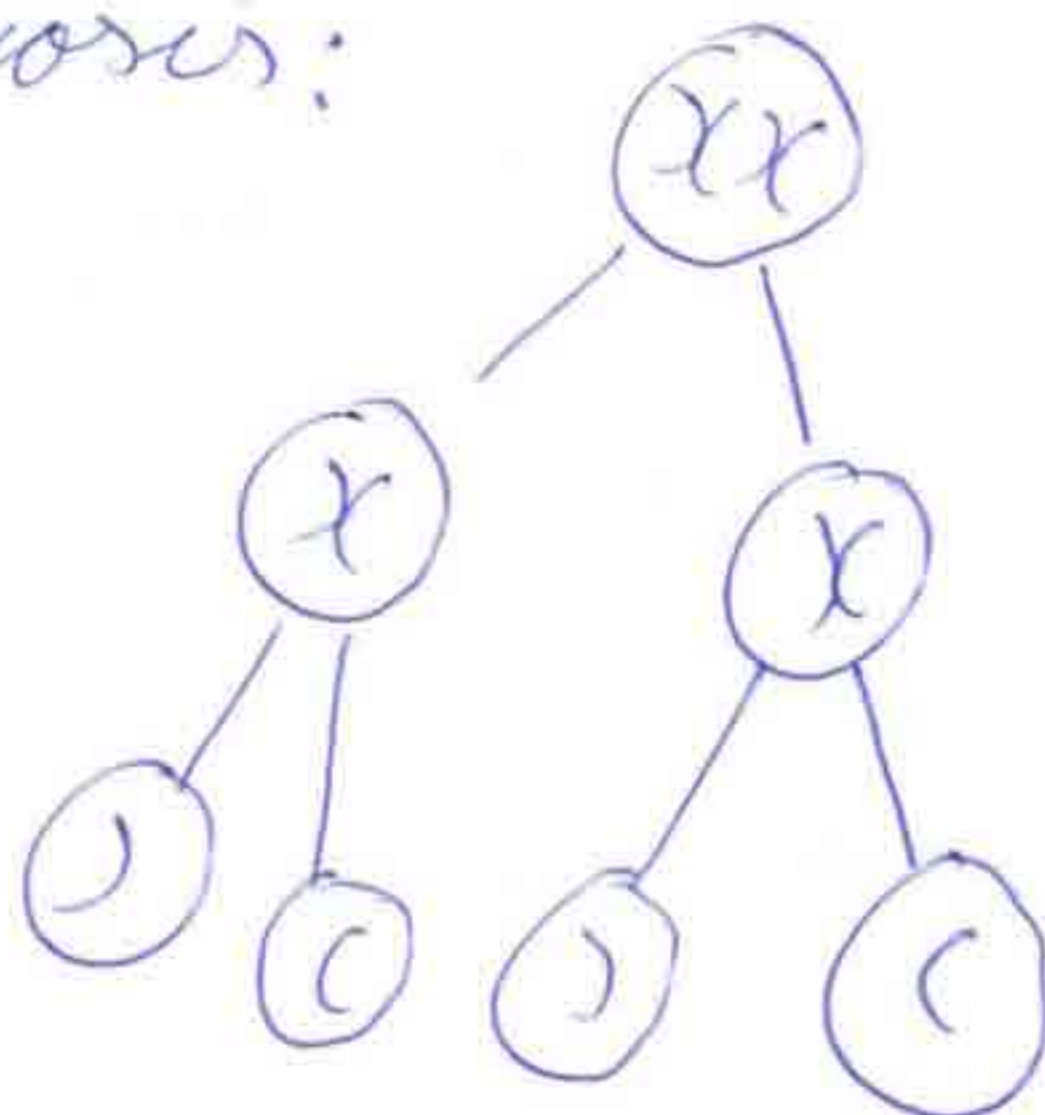
⑧ Mitosis:



is a process of cell division of growth. ✓

So the complete set of chromosome is duplicated in each cell. ✓ since each cell contains a complete set of genetic information. the amount of chromosomes in each cells stays the same (2 in each) ✓

Meiosis:



the process of genetic cell division for reproduction. ✓

we get 1 set of chromosome from our mother and 1 from our father, in the process of conception there 2 (sperm and egg) merge. ✓

Our body produces this by splitting the 1 cell 2 times which gives us 4 set of $\frac{1}{2}$ of our genetic heritage. ✓

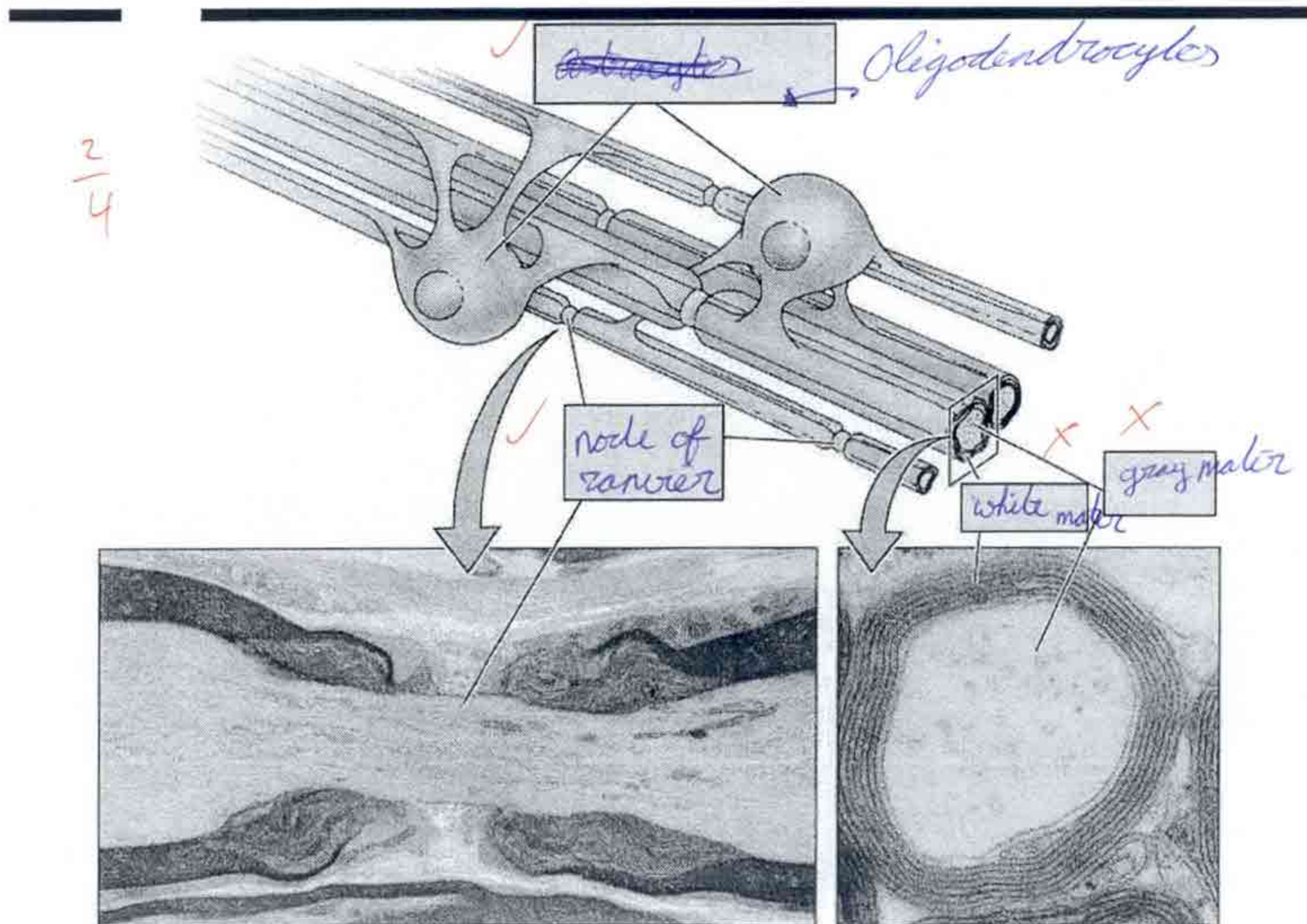
4.5/5 ⑦ Cerebral Spinal Fluid's function:

- De-pressures the brain, in water we all feel lighter?
- ✓ • Provides protection for when we bump our head, it's a cushion.
- ✓ • It is produced by Choroid plexus and is recycled 3 times a day.
- it moves through the ventricles and fills up
- ✓ the ^{SUB}arachnoid space, it leaves through the ^{vertebra} column to rest of body. where else -0.5
- a disease or infection regarding CSF is Hydrophalon
- ✓ When there is a delaying of CSP in the brain and can't go out, thus your head becomes a "waterhead" which is dangerous and suppresses the brain, too much pressure can be deadly. ✓

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Part 4 – Labeling (15 points; 1 point for each label)

(4 points)

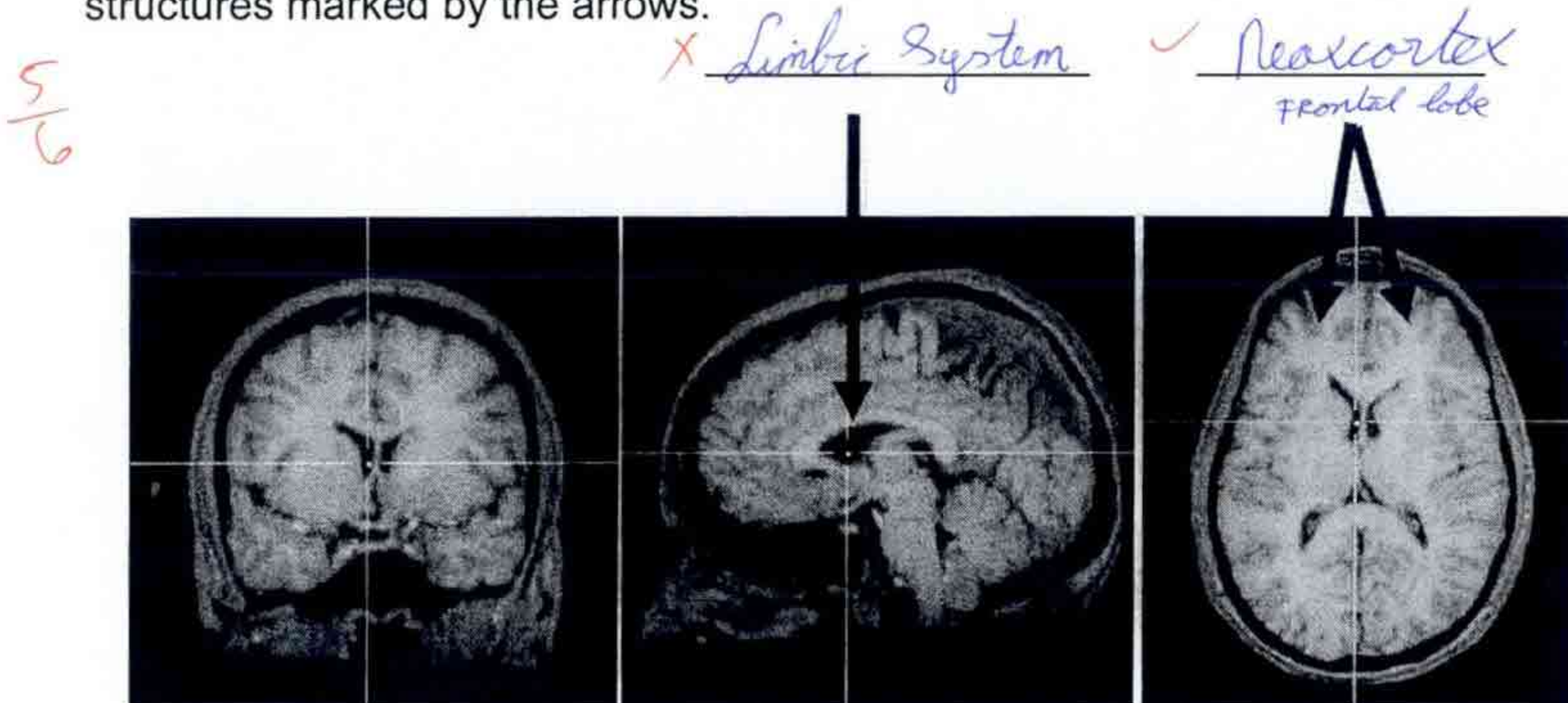


(6 points)

A. The white cross is positioned on the same structure in all the three planes.

✓ This structure is the second lateral ventricle.

Write the name of each plane under each figure, and fill the name of the structures marked by the arrows.



Coronal section
Caudal posterior view

✓ Sagittal section
→ Sagittal view

✓ Axial section
Dorsal Superior view

A brain surgeon, who needs to remove a tumor from a sub-cortical structure, will "meet" the following layers on the way:

(5 points)

